A brain cancer is a disease in which cells grow uncontrollably in the brain. Brain tumors are of two main types: 1) Benign tumors 2) Malignant tumors. Benign tumors[1] are incapable of spreading beyond the brain itself. Benign tumors in the brain usually do not need to be treated and their growth is self-limited. Sometimes they cause problems because of their location and surgery or radiation can be helpful. Malignant tumors are typically called brain cancer. These tumors can spread outside of the brain. Malignant tumors of the brain will always develop into a problem if left untreated and an aggressive approach is almost always warranted. Brain malignancies can be divided into two categories: Primary brain cancer originated in the brain. Secondary or metastatic brain cancer spreads to the brain from another site in the body. Cancer occurs when cells in the body divide without control or order. Normally, cells divide in a regulated manner. If cells keep dividing uncontrollably when new cells are not needed, a mass of tissue forms, called a growth or tumor. The term cancer usually refers to malignant tumors, which can invade nearby tissues and can spread to other parts of the body.

An artificial neural network (ANN) [2] is an information processing system which contains a large number of highly interconnected processing neurons. These neurons work together in a distributed manner to learn from the input information, to coordinate internal processing, and to optimise its final output. Neural networks covering medical image registration, segmentation and edge detection for medical image content analysis, computer-aided detection. Other applications of ANN include data compression, image enhancement and noise suppression, and disease prediction etc. More recently, application of ANN for functional magnetic resonance imaging (fMRI) simulation becomes a new research hotspot, where certain structured ANNs are employed to simulate the functional connectivity of brain networks. Due to the similar nature of ANN and human neurons, ANN has been proved to be a very useful for this new task.

Segmentation is an important process to extract information from complex medical images[8]. Segmentation has wide application in medical field. The main objective of the image segmentation is to partition an image into mutually exclusive and exhausted regions such that each region of interest is spatially contiguous and the pixels within the region are homogeneous with respect to a predefined criterion. Widely used homogeneity criteria include values of intensity, texture, color, range, surface normal and surface curvatures. The field of medical imaging and soft computing have made significant survey in the field of image segmentation. Image segmentation techniques can be classified as based on edge detection, region or surface growing, threshold level, classifier such as Hierarchical Self-Organizing Map (HSOM) [9]. Image thresholding is the most popular segmentation method due to its intuitive properties and simple implementation [11]. Threshold selection plays a very crucial role for efficient segmentation results. Intuitively, the thresholds for multimodal histograms should be the minima between the two maxima. Some techniques sharpen the histogram peaks in image enhancement stage so as to facilitate the threshold detection. The main disadvantage of this method is the difficulty to separate...
object from background if the object and background are of the same intensity distribution or texture as in MRI-scans. Edge-based segmentation [21] is described in terms of discontinuities in image attributes as Gray level, texture, color etc. These discontinuities are known as edges and are detected using edge detection operators. Some of the commonly used operators are Sobel, Prewitt, Laplace, etc. Segmentation resulting from edge-based method cannot be used as partial segmented output due to the presence of broken, stray, or noise edges.

Region-based segmentation is then used which is based on finding similarity measures to merge and split regions in an image so as to form semantic or useful division in the processed image. Self Organizing Map, SOM, as part of competitive learning neural network (CLNN) has been used to implement the vector quantization process. The importance of SOM for vector quantization is primarily due to the similarity between the competitive learning process employed in the SOM [9] and the vector quantization procedure.

HSOM is the combination of self organization and topographic mapping technique [9]. HSOM combines the idea of regarding the image segmentation process as one of data abstraction where the segmented image is the final domain independent abstraction of the input image. There are several image processing techniques such as histogram equalization, image segmentation, image enhancement, morphological operations and feature extraction have been developed for detection of the brain tumor in the MRI images of the cancer affected patients. Many techniques have been reported for classification of brain tumors in MR Images. Most notably support vector machine, neural network ,knowledge based techniques , expectation maximization algorithms and fuzzy C-means Clustering.

1. Histogram Equalization

One wishes to compare two or more images on a specific basis, such as texture it is common to first normalize their histogram to a standard histogram. This can be especially useful when the image have been acquired under different circumstances. The most common histogram normalization technique is histogram equalization where one attempts to change the histogram through the use of a function [1]. The types of operations that can be applied to digital images to transform an input image a[m,n] to an output image b[m,n] can be classified into 3 categories.

* Point-The output value at a specific co-ordinate is dependent only on the input value at that same co-ordinate.
* Local-The output value at a specific co-ordinate is dependent on the input values in the neighborhood of that same co-ordinate.
* Global-the output value at a specific co-ordinate is dependent on all the values in the input image.

Types of neighbors

Neighborhood operations play a key role in modern digital image processing. It is therefore important to understand how images can be sampled and how that relates to the various neighborhood that can be used to process an image. Contrast stretching is a histogram based operation in this an image is scanned in such a way that the resulting brightness values do not make full use of the available dynamic range.

2. Image Segmentation

Image segmentation plays a major role in the field of biomedical applications. The segmentation technique is widely used by the radiologists to segment the input medical image into meaningful regions. The segmentation of brain tumor from MRI is an important but time consuming task performed by medical experts. The digital image processing community has developed several segmentation methods. There is also a multiscale image segmentation using a hierarchical self organizing map , a high speed parallel fuzzy c-mean algorithm for brain tumor segmentation. Two very simple image segmentation techniques that are based on grey level histogram of an image.

* Thresholding
* Clustering

3. Image Enhancement

Image enhancement is needed to increase the contrast between the whole brain and the tumor. Sharpening filter is used to enhance the contrast between the tumor region.

4. Morphological Operation

Morphological [18] dilation and Erosion operators are used to connect isolated candidate text edges in each detail component sub-band of the binary image. The dilation operator is used for filling the broken gaps at the edges and to have continuities at the boundaries Onto the dilated image a filling operator is applied to fill the close contours .After filling operation on an image, Centroids are calculated to localize the regions.

5. Feature Extraction

Discrete wavelet transform is used to extract the features. DWT is a well known tool for extracting frequency space information from non stationary signals. This DWT of MRI have been reduced using principle Component Analysis to more essential features.DWT allow Analysis of image at various levels of extraction.

CLASSIFICATION

1. SUPPORT VECTOR MACHINE CLASSIFIER

SVM is a binary classifier. SVM [21] is a pattern recognition algorithm which learns to assign labels to objects through examples. The spectral features of these images are extracted and are preprocessed. The statistical features from the images are collected and supplied to SVM feature space. As the Tumor images presents a distinct cluster in the feature space a linear SVM classifier is sufficient and it can easily generate a completely separable spaces. At the detection stage the features of the input images are plotted on the hyper plane and Euclidian distance is calculated from each group. The smallest distance is considered as the detected class. Thus the image can be classified as either a tumor image or a non-tumor image.

Figure 1: Normal Brain
Shally et al. / Review of Brain Tumor Detection Techniques From MRI Images

2. ARTIFICIAL NEURAL NETWORK

A neural network is a massively parallel distributed processor that has a natural propensity for storing experiential knowledge and making it available for use. It resembles the brain in two respects.

1. Knowledge is acquired by the network through a learning process.
2. Interconnection strengths known as synaptic weights are used to store the knowledge.

Leaning is a process by which the synaptic weights are adapted through a continuing process of stimulation by the environment in which the network is embedded. The type of learning is determined by the manner in which the parameter takes place.

3. K-NEAREST NEIGHBOR

K-nearest neighbour [13] is one of the simplest pattern recognition classification techniques. The algorithm for the nearest neighbour rule is summarized as follows. Given an unknown feature vector \( x \) and a distance measure \( d \).

* Out of the \( N \) training vectors, identify the \( k \) nearest neighbours, irrespective of class label. \( K \) is chosen to be odd.

* Out of these \( k \) samples, identify the number of vectors \( k_i \) that belong to class \( w_i \) for \( i = 1, 2, \ldots, m \) obviously \( \sum_{k=1}^{k} k_i = k \).

* Assign \( x \) to the class \( w_i \) with the maximum number \( k_i \) of samples.

The value of \( k \) is tuned until the maximum level of accuracy is achieved.

CONCLUSION

A survey of brain tumor detection has been done based on several classifications. The use of computer technology in medical decision support is now widespread and pervasive across a wide range of medical areas. MRI plays an important role in progressive research. First, we have seen some basic image processing techniques, then we have done, a detailed analysis of different classifiers. They are Support Vector machine, Artificial neural network and K-nearest neighbor.

REFERENCES


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